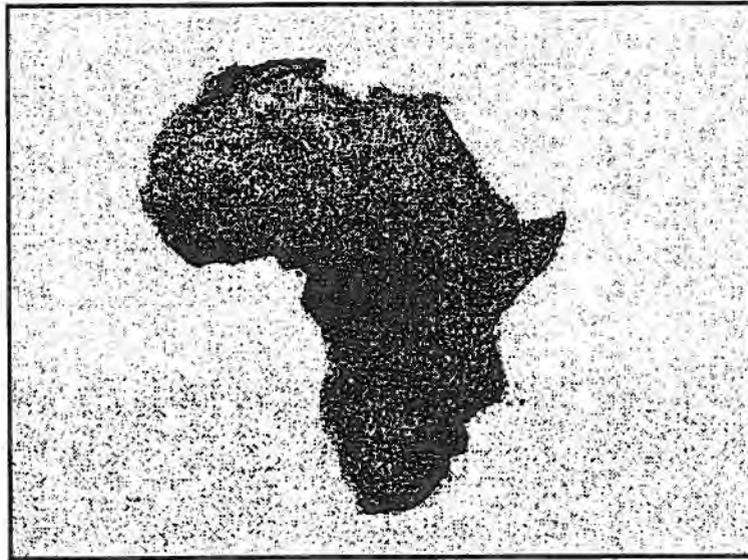


AN ASSESSMENT OF
STRATEGIC OPPORTUNITIES
FOR SUSTAINABLE
AGRICULTURAL INTENSIFICATION
IN SUB-SAHARAN AFRICA

A Survey Team Report Commissioned by
The Carter Center and USAID

October 1997

 Winrock International



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FOREWORD

A survey team commissioned by The Carter Center of Atlanta, Georgia, and the U.S. Agency for International Development (USAID) was asked to examine opportunities to improve the agricultural sector in Sub-Saharan Africa (SSA) by intensifying production of basic food crops and identifying problems or constraints that might limit intensification. The team prepared this report.

The team's work complements the extensive efforts during the past decade of the Sasakawa-Global 2000 (SG 2000) Agricultural Program — of which The Carter Center is a principal partner — under the direction of Nobel Peace laureate Dr. Norman Borlaug, and financed by the Nippon Foundation of Japan.

During August and September, 1997, the team reviewed relevant material and spent three and one-half weeks visiting three countries in which the SG 2000 program has been active: Ghana, Uganda, and Ethiopia. In each country, the team met with government officials, private sector leaders, nongovernmental organizations (NGOs), bilateral and multilateral donors, farmers, and other groups. In Ethiopia, the team also participated in an annual SG 2000 workshop attended by agricultural leaders from the 12 countries in which SG 2000 is working, and representatives from the international agricultural research community, United Nations organizations, donors, the private sector, and others involved in the SG 2000 program. President Carter and Dr. Borlaug provided leadership for the workshop.

A primary objective of the team's mission was to identify opportunities for the international donor community, including USAID, to contribute to efforts aimed at achieving sustainable agricultural intensification in the region.

Sub-Saharan Africa has a wide range of ecologies that differ greatly in potential for agricultural intensification. While the need for agricultural development in areas with low potential is important, the greatest opportunities for increasing agricultural productivity and improving national economic well-being lie in high-potential zones. The report, therefore, focuses on opportunities for significant progress in areas with the greatest potential for increased production.

This brief report focuses on a few key problems, among many, and makes recommendations for action in areas believed to offer the greatest and most immediate opportunities for improvement. Because circumstances vary from country to country throughout the region, each location will require activities to address specific

circumstances. The team has attempted to identify constraints that appear to be most pervasive in limiting notable improvements in the agricultural sector. The most significant social and economic progress can be realized if these major deterrents to agricultural intensification can be addressed successfully.

Special appreciation is extended to Christopher Dowswell, Director for Program Coordination, Sasakawa Africa Association; and Andrew Agle, Director of Operations, Global 2000, The Carter Center—both of whom provided valuable input to the efforts of the team. The team is also indebted to Winrock International and Dr. Henk Knipscheer for providing logistical support.

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SUMMARY

There is overwhelming evidence in recent decades that Sub-Saharan Africa has not enjoyed the economic and social progress occurring in other parts of the world. This is of great concern to national governments within the region as well as to the international donor community. A high percentage of the people in this vast subcontinent depend on agriculture for their livelihood. Improvements within the sector can unlock the door to social and economic improvement. Indeed, agriculture must be the engine for economic and social progress.

Various efforts, especially those of the Sasakawa-Global 2000 agricultural program, have demonstrated the potential for a marked increase in food crop production resulting from use of inorganic fertilizers, improved seed varieties, timely weed control. Yet, many problems or constraints may keep the average farmer from benefiting from these technologies.

A team commissioned by The Carter Center and USAID surveyed opportunities for agricultural intensification in SSA and identified a number of constraints that limit such intensification. This report focuses on the following areas to make significant improvements in the region's agricultural sector and thus contribute greatly to overall economic and social progress:

Macro-economic and sector policies	Agricultural research
Agricultural extension	Rural credit
Agricultural input supply	Agricultural marketing systems
Physical infrastructure	

This report summarizes an extensive array of problems that severely limit progress. While some advancement is taking place, it is not great enough or rapid enough to confront poverty and human misery so pervasive throughout the region. From many standpoints, it is in the interest of the global community for this region of more than a half-billion people to improve itself and have a more stable and prosperous future. Both national and international private sector interests have excellent opportunities for greater investments in the region. Moreover, there is urgent need for international donors to intensify their efforts in assisting the nations of Sub-Saharan Africa make improvements in their agricultural economies that are essential for further progress. The avenues for assistance highlighted herein should contribute greatly to reaching this goal.



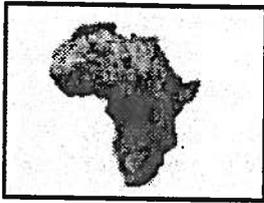
THE ESCALATING SOCIAL AND ECONOMIC CRISIS IN SUB-SAHARAN AFRICA

In the past decade, volumes have been written about the overwhelming social and economic crisis in Sub-Saharan Africa. This is a crisis of people—indeed, hundreds of millions of people—beset with abject poverty, debilitating diseases, widespread hunger and malnutrition, inadequate educational opportunities and, perhaps most disturbingly of all, little apparent hope for the future. A few simple facts illustrate the problem:

- Eighty percent of the world's poorest countries are in Africa. . . . Since 1960 the standard of living in Sub-Saharan Africa has stagnated or fallen, unlike Asia and other continents. (Antoine, 1993)
- The World Bank estimates that half of the population of Sub-Saharan Africa lives below the poverty level and subsists on per capita income of less than \$1 per day. (IFPRI, 1995)
- Some 30 million preschool-aged children are significantly malnourished. Unless significant improvements are made, there will be a dramatic increase in malnourished children by the year 2020. (IFPRI, 1995.)
- With a projected average annual growth rate of nearly 3 percent, the population of Sub-Saharan Africa will likely triple in the next 30 years, before the rate slows significantly. This represents the highest growth rate of any region of the world. (World Development Report, 1996)
- For several decades, rapid population growth has greatly exceeded the growth of food production. (IFPRI, 1996) Of the major developing regions of the world, only in Sub-Saharan Africa has per capita food and agricultural production been declining. (FAO, 1995) (USDA, 1993)
- Sub-Saharan Africa was a food exporter until the 1970s when it became a net importer. By the mid-1980s, the region's net food imports were increasing. Cereal food aid to the region increased from 1.6 to 5.1 million tons between 1979 and 1980 and again between 1992 and 1993, while cereal imports grew from 8.6 to 13.1 million tons for the same period. (World Development Report, 1995)
- The International Food Policy Research Institute (IFPRI) estimates indicate that by the year 2020, Africa will need to import about 30 million tons of cereal each year to fill the gap between projected market demand and supply. If all Africans were fed at nutritionally-desired levels, Sub-Saharan Africa would need an additional 185 million tons annually from increased production or other sources. (Abdulai and Hazell, 1995)

- Much of Africa's land is threatened by degradation as rural people put their short-term survival needs ahead of resource sustainability—as was done by today's industrialized nations during the early stages of their development.
- The agricultural sector dominates the economies of most Sub-Saharan countries. Despite this, the International Food Policy Research Institute (IFPRI) indicates that donor assistance declined in the 1980s. This downward trend has accelerated since 1990. Moreover, bilateral assistance to agriculture by major donors also has declined since 1990. (Abdulai and Delgado, 1995)

Significant structural adjustments and other advancements within the last decade, including more attention to agriculture, should contribute to longer-term improved conditions across Sub-Saharan countries. The remainder of this report will focus on exciting opportunities for other critical needed improvements.



RESPONSE TO THE CRISIS THROUGH AGRICULTURAL INTENSIFICATION

Although Sub-Saharan Africa has vast unused land, much of the region has serious problems or constraints that severely limit major increases in production by expanding areas under cultivation (horizontal expansion). Moreover, horizontal expansion causes farmers to move onto more environmentally-fragile lands, thereby contributing to further natural resource degradation. More intensive — rather than extensive — agricultural production is necessary to feed Africa's growing population and preserve its natural resource base. Efforts must be made to intensify production *vertically* — by significantly increasing agricultural production on land currently in use. Technology is available to support such intensification.

Significant intensification of agriculture depends on the adoption of modern technology, especially much greater use of inorganic fertilizers and improved cultivating equipment. In many areas lack of animal traction or equipment to till the land, beyond human labor, may hamper efforts. There is great need to raise productivity of land and labor to radically reduce poverty, which is the cause of food insecurity and environmental degradation.

■ Agricultural Intensification: The Engine of Economic Growth in Africa

In most African countries, basic foods are relatively expensive and in short supply because of the inefficient, low-yielding technologies employed in the ubiquitous small-scale farming sector. These traditional technologies neither supply the farmer with an adequate income nor the consumer with affordably-priced food. This situation must change.

It is important to understand the impact high-yielding food crop technologies can have on poverty reduction and human progress in Africa. More plentiful and efficiently-produced foods can lower real prices, which effectively means increased income for all consumers. In these cases, the poor benefit more, since they spend a larger percentage of their income for food. Higher wages increase consumer purchasing power, which, in turn, leads to increased economic growth throughout the economy. Improvements in the agricultural sector can become, and must become, the engine to drive economic development.

Widespread adoption of higher-yielding food production technologies also will protect wildlife habitat. Resource-poor farmers will be under less pressure to bring new, often unsuited, land under cultivation because soil fertility and production will be improved on existing land. This is a matter with potentially enormous

environmental consequences for future generations.

Many national agricultural development plans in Africa give priority to “agricultural diversification” and “promotion of export-oriented crops.” While these are important objectives, securing the food production base also is imperative. Without the rapid adoption of improved, high-yielding food production technologies, efforts to reduce poverty and attain food security in Sub-Saharan Africa will fall far short of their marks.

■ Limitations of the Natural Resource Base

Soils and Rainfall. Sub-Saharan soils are relatively infertile, in contrast with the plentiful alluvial and volcanic soils of South and Southeast Asia. West African soil fertility is low because it is formed of old land that has eroded without rejuvenation by volcanic activity or alluvial deposits. These soils contain little weatherable minerals to provide plant nutrients. Crops respond initially to nitrogen and phosphate applications, but intensive cultivation creates deficiencies of potassium, calcium, magnesium, sulfur, and minor elements. The volcanic-derived soils of the Rift Valley region in East Africa are much younger, have more weatherable minerals, and can be quite productive, particularly with addition of nitrogen fertilizer. The soils of Central and Southern Africa generally have better physical properties than those of West Africa, but they are low in nutrients and become depleted quickly under normal agricultural use.

Agricultural production can be intensified by using nitrogen and phosphorus, inorganic (mineral) fertilizers. However, sustaining high production levels involves more complex nutrient management systems that include other major and minor elements and organic matter.

Increasing the levels of organic matter is important. Most farmers will use farmyard manure if it is available; but manure is not always in supply, because of limited animal populations or because it is used as fuel for home cooking. Frequently manure has reduced nutrient content because of inadequate storage techniques and poor animal diets. *The best way to improve the organic status of soils is to grow good crops so more crop residues accumulate.*

Wet equatorial climates, with annual rainfalls greater than 2,000 mm, primarily occur within five degrees north and south of the equator. In Sub-Saharan Africa, these climates are confined to the Congo basin and a narrow strip of West Africa where two periods of peak rainfall are intervened with spells of drier conditions. Farmers have two growing seasons and may have problems drying the harvest during wet weather. Further north and south of the equator are areas with one long wet season, rainfall of 750 to 1,250 mm, and a long dry season of 5 to 6 months. Risks of drought at planting and(or) during the growing season are endemic in many areas.

Agriculture and Land Use. The dominant food production system in Sub-Saharan Africa is annual rainfed crops, supplemented in West Africa by perennial crops, fruits, and a range of exotic and indigenous vegetables. Many farming systems are characterized by the multiplicity of crops grown by individual households. Monocropping is important for cereal production, particularly where these crops are grown for domestic consumption and for market, as well as export crops, such as cotton. Small ruminants and poultry are common and enhance diet and income. Cattle are excluded from large regions because of trypanosomiasis.

Land rotation with bush or grass fallows, often referred to as “shifting cultivation,” remains the dominant farming technique in many areas. It is being replaced by many forms of continuous cultivation that, without adding nutrients, leads to declining yields and increased food insecurity. Soil nutrient loss is well documented in many countries because of shorter or eliminated fallow periods.

Humans provide the majority of energy used in Sub-Saharan agriculture, while animals provide more than 70 percent of energy used in India. The need for additional energy in the region is obvious. For instance, an ox generates about 10 times as much energy as an able-bodied person. Chemical energy in the form of fertilizers and herbicides can help by making human labor more efficient and productive.

There has been little investment in land improvements, such as contour ridges and bands, catchment basins, terracing or irrigation, although some small-scale irrigation has been developed. Several factors are responsible. Traditional land tenure systems with unclear ownership may play a part. Another critical factor is the lack of population pressure and resulting demand for more productivity until the last two to three decades. A third factor may be the inherent low fertility of Sub-Saharan soils. Increasing the fertility of these soils is likely to encourage farmers to invest in further land improvements.

Natural Resource Degradation. There are four aspects of natural resource degradation. “Mining” the soil by removing plant nutrients during the farming practices described above is the leading cause of environmental degradation. In many Sub-Saharan countries, nutrient removal is estimated to exceed nutrient replacement by a factor of 3 or 4. This results in an annual loss of more than 8 million tons of nutrients from the 200 million hectares under cultivation (Stoorvogel and Smaling, 1990). Clearing forests to extend cultivation and cutting trees for domestic fuel wood are major contributors to degradation, followed by insidious soil erosion, river siltation, and destruction of cultivable land.

Major improvements in soil fertility or nutritional status are imperative if agriculture in Sub-Saharan Africa is to achieve the widely-recognized and much-needed goal of 4 percent annual production increase (Cleaver, 1993); (Cleaver and Schrieber, 1994); (World Bank, 1989). This need must be met primarily through the use of significantly greater quantities of inorganic fertilizers.

Cropping systems using limited application of fertilizers, as advocated by some, inevitably will contribute to continued low agricultural productivity and poor economic conditions throughout the region.

Inorganic fertilizers used in the amounts currently being recommended for food crops in the region pose no threat to the environment, as some suggest. To the contrary, high-yield agricultural production technology, properly applied in areas with good crop production potential, can save vast areas of fragile land for other uses—forestry, wildlife habitats, watershed protection, and outdoor recreation. Greater use of inorganic fertilizers can be, and has been, a major contributor to making this possible.

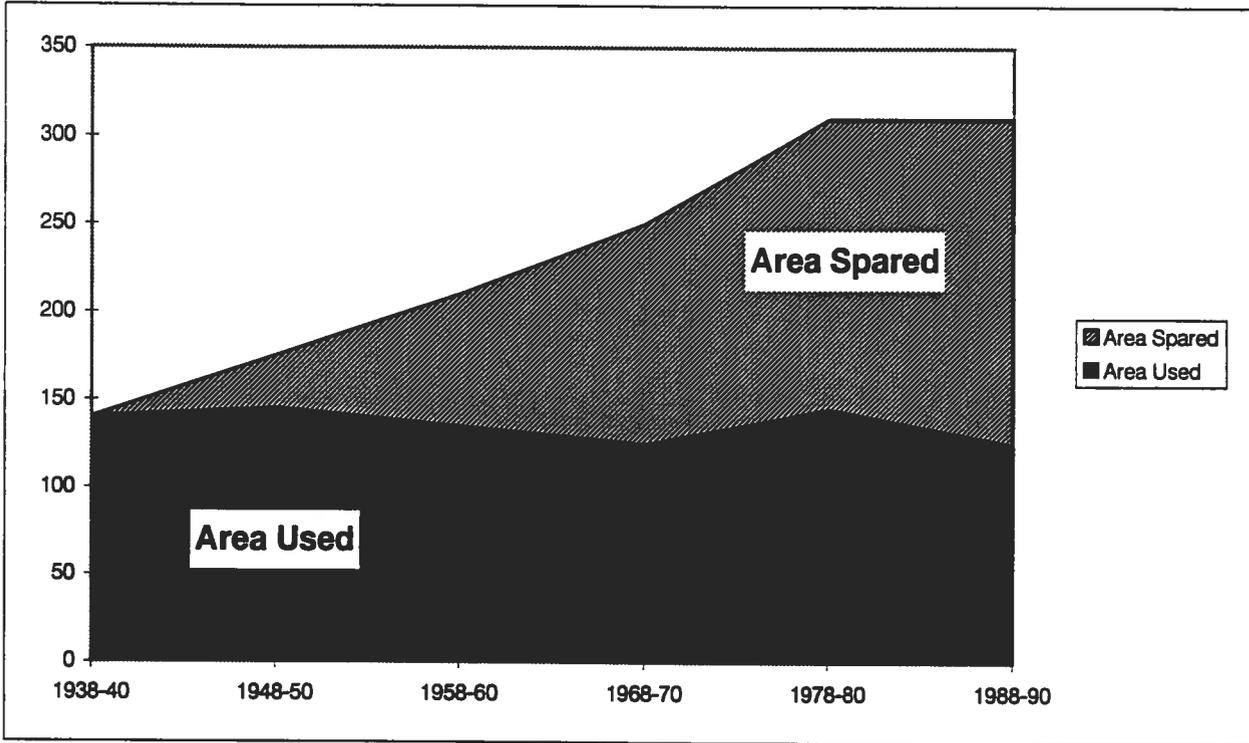
For example, Figure 1 indicates that in the 50-year period between 1938-40 and 1988-90, the production of 17 food, feed, and fiber crops in the United States more than doubled, while the land required for this production was reduced by more than one-half. Similar findings in China, India, and other developing regions where significant progress in agricultural productivity has been made through greater use of inorganic fertilizers and other improved technologies. Land “spared” from, or not needed for, crop production could be planted in trees or converted to grasslands suitable for wildlife habitats and other conservation-related uses.

■ Other Constraints Limiting Agricultural Intensification

Although low soil fertility across Sub-Saharan Africa remains a deterrent to agricultural intensification, a number of other constraints also limit agricultural advances in the region. These constraints, detailed in the literature, are summarized here and vary in impact from country to country.

- Farmgate prices for agricultural commodities often are only a fraction of world market prices. Prices frequently are too low to encourage farmers to increase production.
- Foreign exchange shortages and unstable exchange rates discourage the use of modern inputs and private sector participation in agribusiness development.
- Poorly developed market systems for agricultural products, including storage facilities, contribute to widely fluctuating prices for farm products and inadequate returns to farmers.
- Excessive export taxes on agricultural commodities lower returns to farmers.
- Farmers have a weak voice in influencing government decisions regarding agriculture. There is an obvious need for greater farmer participation and empowerment. This need is especially acute for women who constitute a major and vital force in Sub-Saharan agriculture.

Million Ha



1938-40 Production: 252 million tons

1938-90 Production: 596 million tons

Figure 1. USA total crop area spared by application of improved technology on 17 food, feed and fiber crops in period 1938-40 to 1988-90

- Sub-Saharan countries, on average, devote less than 10 percent of their annual budgets to agriculture although most of their people are involved in agriculture and it is the primary contributor to gross domestic product. This leads to seriously inadequate funding for agricultural programs.
- Over-valued exchange rates diminish the ability of domestically-produced commodities to compete with imports.
- Weak research and extension programs do not communicate improved technologies to farmers.
- Inadequate physical infrastructure, especially rural roads, port facilities, railroads, and other transport systems, result in high transportation costs which add to the expense of farm inputs and reduce earnings for farm products.
- Poor telecommunications systems, especially to rural areas, adversely affect the ability of farmers to function efficiently.
- In many countries, public and private firms have not developed adequately to provide needed farm services such as input supply, marketing, and credit.
- Inadequate credit for farm inputs such as fertilizers, improved seed varieties, and agriculturally-related materials, make it difficult to access improved technology.
- Land tenure systems discourage farmers from making long-term land improvements and limit efforts to obtain needed credit for agricultural production.
- The risk of inadequate rainfall and adverse fertilizer/crop price ratios often discourage farmers from using inputs such as fertilizers.
- Poor rural social infrastructure, including health services, educational opportunities and potable water supplies result, in part, from an excessive urban bias where primary emphasis is given to developing the infrastructure of urban areas.
- Inadequate family planning that results in the highest population growth rate in the world makes it difficult for Sub-Saharan countries to significantly increase per capita food production and income.
- Many countries experience foreign exchange shortages and unstable exchange rates.

Although efforts are being made to address many of these problems, and some progress is evident, significant difficulties that demand attention remain.

■ The Sasakawa-Global 2000 Agricultural Program

For the past 11 years, the Sasakawa-Global 2000 (SG 2000) agricultural program has operated technology transfer projects to demonstrate opportunities for agricultural intensification in Sub-Saharan Africa. The SG 2000 program is a partnership of two nongovernmental organizations: the Sasakawa Africa Association, whose president is Norman Borlaug; and the Global 2000 program of The Carter Center, whose chairman is President Jimmy Carter. The Sasakawa Africa Association is responsible for program management while Global 2000's specialty is to engage, through President Carter, in policy-related interventions.

The SG 2000's mission is to assist governments in Sub-Saharan Africa reduce poverty, enhance food security, and protect the natural resource base through accelerated adoption of productivity-enhancing agricultural technology.

In 1997, field programs were under way in Benin, Burkina Faso, Eritrea, Ethiopia, Ghana, Guinea, Mali, Mozambique, northern Nigeria, Tanzania, Togo, and Uganda. Previously, field programs also were active in Sudan and Zambia. Satellite activities, involving exchange visits and limited technical assistance, are implemented in neighboring SG 2000 project countries.

The SG 2000 works mainly with ministries of agriculture and national extension services, as well as with national and international agricultural research systems. Six expatriate field directors manage and supervise the 12 SG 2000 country projects with the assistance of local professionals and support staff. Two expatriate staff supervise multi-country programs to strengthen university-level extension education and agroprocessing micro-enterprise development.

Typical Program Components. Although SG 2000 staff are concerned with a broad range of agricultural development issues, about two-thirds of total funding supports ministry of agriculture field testing/demonstration programs for small-scale farmers to identify and introduce improved food crop production and postharvest technologies.

To complement SG 2000 financial and human resources, partnerships are being established with other organizations, including the World Bank, other bilateral donors, and various NGOs. While one blueprint does not fit every country project, the main program themes are:

- Accelerate small-scale farmer adoption of modern production technologies (fertilizers, improved seeds, improved agronomic practices, crop protection chemicals) for food crops — mainly maize, wheat, sorghum, rice, cassava, grain legumes, and potatoes. A special effort is being made to introduce quality protein maize (QPM), a nutritionally-superior maize that looks and tastes like normal varieties, has good yield performance, and has substantially higher levels of two essential amino acids: lysine and tryptophan.

- Restore and maintain soil fertility through increased use of chemical fertilizer as the core strategy supplemented by various organic and indigenous mineral sources.
- Introduce additional energy into small-scale food production systems through improved draft power (animals, small two-wheel Chinese/Korean tractors, other implements, small-scale machinery) and conservation tillage systems using herbicides.
- Expand on-farm grain storage capacity to bring higher prices and to ensure greater food safety and security.
- Introduce cost-reducing, labor-saving agroprocessing technology suitable for micro-enterprise development, with priority on identifying new income-earning opportunities for women's groups.
- Promote establishment of farmers' associations for saving and loan services, input supply, and output marketing.
- Promote establishment of private enterprises that can serve the smallholder farming sector, especially for improved seed, fertilizers, and crop protection chemicals.

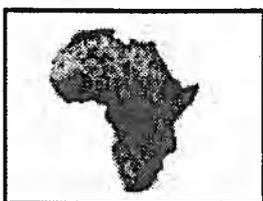
The SG 2000 program also has initiated two related efforts.

- The Sasakawa Africa Fund for Extension Education program offers scholarships to outstanding extension staff. Technical assistance is provided to several African agricultural universities for curriculum development and modest start-up grants to establish practical, hands-on extension courses for mid-career extension staff.
- The Agribusiness Forum is an initiative with a number of major transnational agribusinesses to encourage increased investments in Sub-Saharan Africa. Beyond policy level assistance, SG 2000 is collaborating with various companies on activities at the grass roots level designed to accelerate the extension of services to the smallholder farming sector.

Impact of the Sasakawa-Global 2000 Program. While Sasakawa-Global 2000 does not claim to be the determining factor influencing national production, statistics from project countries over the past decade demonstrate progress:

- Sudan increased irrigated wheat production by 400 percent from 1987 to 1992;
- Ghana doubled rainfed maize production between 1986 and 1996;
- Northern Nigeria increased maize production 50 percent from 1993 to 1996; and;
- Ethiopia increased its cereal production by 100 percent during the 1992 to 1996 period.

In all these cases, yield increases have been a significant factor in the production gains made. However, most farmers have not been able to sustain use of the full set of practices — especially recommended fertilizer levels — since input costs have increased significantly more than output prices. Although efforts should be made to reduce input costs and increase output prices, there also is great need for additional research to improve the efficiency of input use.



OPPORTUNITIES FOR ENHANCED SUPPORT OF AGRICULTURAL IMPROVEMENT EFFORTS

Despite the constraints outlined, evidence of significant potential for agricultural intensification in Sub-Saharan Africa is abundant. The international donor community has excellent opportunities to support national governments by investing in programs that contribute to the reaching this potential and greatly affect the economies of the region. For donor support to be effective, however, it is imperative that national governments recognize the vital role agriculture must play as the engine for economic and social progress. Furthermore, they must be willing to give agricultural improvement efforts high priority in planning and action programs.

■ Areas Demanding Attention

There are obvious links between the selected recommendations for enhanced agricultural intensification in Sub-Saharan Africa that follow. An integrated development approach is needed to maximize returns from these activities.

Macro-Economic and Sector Policies

Economic and political policies provide the framework or “rules of the game” which guide economic decisions. A sound policy environment provides incentives to make decisions on agricultural development based on market signals. Alternatively, bad economic policies greatly add to the problems of food-insecure countries.

Government commitment to sustainable agricultural intensification can be demonstrated by allocating a significant percentage of the budget to agriculture, including adequate support for certain “public goods” such as infrastructure, research, and extension; making agricultural programs “performance based”; and establishing an enabling policy environment that includes:

- Foreign exchange rates that are stable and maintain an equilibrium level through market forces.
- National budgets that balance public sector expenditures with revenues.
- Monetary policy that facilitates market-determined interest rates and growth of money supply consistent with stable prices.
- Minimal and uniform tariffs on imports, no or minimal export taxes, and no quantitative restrictions on imports and exports.

Government commitment also can be demonstrated by establishing a level playing field for all market participants. Neutral ground may be created and maintained by a legal, regulatory, judicial, and policy framework that ensures that private markets operate competitively. Such a situation might include:

- Functioning land and water markets with a legal system that allows owners to buy and sell land and water and a banking system that allows the use of these resources as collateral.
- Input distribution and product marketing carried out by the private sector with free entry and exit of firms.
- Assurance of generally accepted weights, measures, grades, and other standards of commerce.
- Accurate, prompt, and open exchange of price and other market information in respective and neighboring countries.

Countries making a demonstrated commitment to agricultural development, a participatory process in program planning and implementation, constructive partnership between public and private institutions, and to transparency in the allocation and disbursement of funds might well receive preference in donor assistance, both for new investments and for relief from outstanding external debts.

Agricultural Research

Farmers need a continuing flow of information and improved technology to intensify their food production systems in economically and biologically sustainable ways. This, in turn, requires that each country plan and develop a national agricultural research system that is closely linked with the global research system. Research institutions must be capable of identifying and solving local problems, either alone or in concert with countries that share the same problems.

Sub-Saharan countries have made some progress developing agricultural research systems over the past three decades. The development of research staff has been particularly impressive. (Roseboom and Pardey, 1996). In this period, the number of researchers has increased six-fold, and the Africanization of staff has increased from 10 to 90 percent, with two-thirds holding postgraduate degrees. However, research funding stopped growing in the late 1970s and has declined in most countries. Spurred by austerity programs, these countries are relying even more on donors to compensate for their own declining funding. Resources increasingly are being spread thin over a growing number of researchers. This has negative consequences for research efficiency and effectiveness.

In making future research funding decisions, national governments and the donor community must be realistic about financial scenarios and employ new performance criteria to help ensure that investments will achieve greater returns than have been realized to date. First and foremost, there is an overriding need to make the *impact*

on farmers' fields the primary measure for funding justification. Second, greater international and regional collaboration is essential (especially in germplasm development, but in other research areas as well) since Sub-Saharan governments cannot afford to duplicate research efforts. National Agricultural Research Systems (NARS) scientists (including university scientists) must be integrated into effective research networks involving International Agricultural Research Center (IARC) scientists. Equitable distribution of operational funding among network partners will add considerably to overall effectiveness of research investments. Third, these national systems must make difficult choices in identifying research priorities — priorities that assure adequate budgetary ratios between personnel and operating costs for effective implementation of a limited, but achievable, set of objectives. Specific areas of research are needed:

Soil Fertility Management. The single most limiting biological constraint to agricultural intensification in Sub-Saharan Africa is soil infertility. Unless something is done to correct this problem, other investments in modern technology will have little benefit. Greater use of inorganic fertilizers must play a central role, not only for agricultural intensification in the higher-potential areas, but also in the resource-poor areas. Approaches to improve the efficiency of fertilizer supply—and thereby reduce farmgate costs—are discussed elsewhere. This section is devoted to research strategies to increase the efficiency of fertilizer use. In doing so, it must be emphasized that the farmer can only maximize benefits from investments in fertilizers where moisture is adequate for crop development and where good agronomic practices — improved seeds, timely sowing, proper plant density, timely weeding, and adequate harvesting and storage — are employed.

Clearly there are many obstacles that biological research cannot remove, such as insecurity of tenure, high transportation costs, and poor communications. However, well targeted social science research can complement biological research and contribute to greater productivity and profitability.

Past national and international research on soil fertility management has provided good knowledge and understanding of problems and basic needs. The problems are predictable and solvable. Findings must now be applied to the complex local settings and adapted to the socioeconomic and biological conditions that exist in these countries. Advice to small farmers on improving soil fertility, because of limited research and extension programs, must be general — reflecting the agro-ecologies as well as agricultural practices of the region. However, more site-specific recommendations can, in time, be developed through well-managed research conducted on representative farms. Some countries already have much information; while others will need to generate it.

Researchers need to identify practical and economically-feasible soil fertility management practices that permit farmers to combine inorganic and organic sources of nutrients. In particular, practices for investigation should include: cropping patterns involving nitrogen-fixing grain legumes and tree/shrub species, the use of plant residues and green manures, and where available, inclusion of local mineral

sources such as phosphate. Where the economics of these technologies are convincing, they should be demonstrated aggressively to farmers.

Water Management. Rainfed farming is predominant across Sub-Saharan Africa. For this type of production, improved practices are needed to capture and use water where it falls. In many areas otherwise suitable for intensification (soils, solar radiation, temperatures), erratic and insufficient moisture is a significant limitation. One option is to shape the soil surface with tillage, either to capture water more effectively or to improve drainage. Another is to create small catchments to store runoff for future use. Finally, there are opportunities to develop small-scale, low-cost irrigation systems, including shallow pumping from streams, lakes, and lands with accessible water tables. In the longer term, investments in larger-scale irrigation systems must be considered.

Germplasm Development. As much as 50 percent of research in developing countries is devoted to plant breeding. The impact of improved varieties is greatest in good environments, while progress is slow and expensive in drought-prone and other less desirable locales. Regardless of the environment, pest and disease resistance is a valuable attribute that can be bred into many species. Resistance breeding has produced impressive results in reducing yield losses, and research should be continued. Over the past decade, the IARCs have increased research to develop germplasm with resistance to abiotic stresses, such as drought, heat and mineral toxicities, and promising results are being obtained. These materials need to be evaluated by NARSs, as well as by farmers, under a much broader range of environments.

Policy Research. Sustainable agricultural development is dependent on sound government policies as well as good technology. Both are indispensable. Despite the biological evidence that current fertilizer and seed technologies can double or triple farm yields in Africa, there is little research on the policy-related constraints that affect the adoption of these technologies in different agroecological environments. More research is needed to alleviate policy-related constraints.

In addition, cash crop production can bring benefits to food crop production. The profits from cash crop production, for which there are often existing effective support systems, can be used to purchase inputs or storage for food crops. Research to develop improved crop management systems that integrate cash and food crop systems could provide important future dividends. Research could incorporate crop sequencing as well as integrated soil fertility and pest management strategies for small-scale farmers. More research also is needed that integrates crop and livestock systems, because animal husbandry is a major source of income for many small-scale farmers.

Agricultural Extension

Agricultural extension for food crops in Sub-Saharan Africa is confined largely to the public domain. Despite varied national and international efforts to improve agricultural technology transfer, national extension services often are characterized as large, inert bureaucracies that have had little positive influence on agricultural development. Problems of staff compensation and training, inadequate operational budgets for field programs, poor linkages with research and farmers, and gender bias are common difficulties.

Today, there are some 150,000 extension workers in ministries of agriculture or parastatals. More than three-fourths of these extension workers have less than a university degree. Within the donor community, the World Bank is the major supporter, having provided financial assistance to 37 Sub-Saharan countries to strengthen extension programs. SG 2000, in a lesser way, has been working the past 11 years to improve the effectiveness of national extension services in 12 countries. These investments have improved the effectiveness of national extension services, but much still remains to be done.

Develop Integrated Research-Extension-Farmer Systems. The need to strengthen links between research-extension-farmers is of paramount importance. Presently, these connections are tenuous at best. Agricultural research and extension organizations often are located in separate ministries, and on-farm research programs are weak. Integrated technology generation systems need to be designed and implemented around organizational and budgetary systems that encourage research and extension to work together on farmers' fields. Linking research and extension organizations into a continuing program of in-service training for front-line extension staff — as advocated by the dominant training and visit system — needs further strengthening. The number of research staff and extension specialists assigned training functions should be increased. Further, much of this training needs reorientation to focus training on the acquisition of "hands-on" practitioner skills, both by front-line extension staff and farmers.

Diversity of agro-ecologies and conditions on the farm call for extension services that can tailor programs to meet varying needs. A national extension directorate is recommended for quality control and to maintain an advisory role on policy formulation and program evaluation. However, specific objectives, identification of clients, detailed activities, methods of communication, and management of field operations should be defined by regional, state, and local governments — in concert with farmers—to reflect specific political, agroecological, and economic priorities. Decentralization can do much to improve farmer focus, compared to the centrally planned extension programs of the past.

Extension workers should play a much more significant role in managing feedback on recommended technologies from the farm to the research station. The more "seamless" the communication and operation between research and extension organizations — and the stronger their integration with the farming community — the greater the return will be from investment in these activities.

Extension services also can become more cost effective if they use modern modes of communication. Traditional face-to-face extension service is expensive and requires a great deal of mobility. Mass communication, either directly through organized groups or by using radio, television, and video displays, can disseminate suitable messages for a larger audience.

Front-line extension workers — and through them, farmers — need to be well-informed about integrated soil fertility management practices that make the most efficient use of inorganic and organic nutrient sources, but which are not too labor-intensive.

Target Women Farmers More Intensively. A particularly serious deficiency today in most Sub-Saharan extension services is the poor link with women farmers. Even though they carry out as much as 70 percent of the agricultural work, women receive only a small fraction of the services provided by agricultural extension. This unacceptable situation must be changed. Because men are the vast majority of extension personnel, they must continue to be the primary conveyors of information in the short term. However, a concerted effort is needed to attract more women and train them for front-line extension positions.

Increase Postharvest Technology Advice. Because most Sub-Saharan Africa countries have underdeveloped food marketing systems, surplus food stocks cannot be moved quickly from local markets to population centers or food-deficit areas. Consequently, boom or bust cycles occur in farmgate prices. Part of the solution is better on-farm storage, which allows farmers to hold grain safely until markets recover from depressed postharvest prices. Another way farmers can add economic value to harvested crops is through processing. Extension needs to become more active in identifying and introducing such postharvest technologies to farmer groups. Obviously, research support will be needed to develop appropriate recommendations.

Increase Economic Advice. As small-scale producers move from subsistence to commercial farming, their need for market information increases substantially. Suppliers and input costs as well as market outlets and prices for surplus production are key concerns of farmers. Extension services should be prepared to make more market intelligence information available to small-scale farmers. Again, research support will be needed to generate this information.

Improve Links with Input Delivery Organizations. Extension officers can play an important role in helping develop input markets. First, by training farmers to make optimum use of improved seeds and fertilizer, they can help stimulate demand for these products. Second, by helping develop farm-level input management information systems, they can provide feedback to input suppliers and researchers, which should help align product mixes closely with farmer requirements. Collaboration with input delivery organizations should be encouraged.

Help Develop Alternate Suppliers of Extension. It is highly unlikely that publicly funded extension services will be sufficient to reach the vast number of small-scale farmers in Sub-Saharan Africa. While much hope is being placed on the private sector and NGOs to fill this void, it will take time for these organizations to develop their coverage and capacity to give sound technical advice. This process can be accelerated if national extension services offer training and support to NGOs and small-scale private enterprises. This could include general training in principles of crop management and animal husbandry, as well as more specialized instruction in the proper use and maintenance of farm equipment, pesticides, and veterinary medicines.

Another possibility for developing alternative extension providers is supplemental government funding to large agribusinesses that work with small-scale farmers who produce cash crops (cotton, coffee, tea, cocoa, vegetables etc.) There are numerous examples of private companies and parastatals that, although primarily concerned with cash crops, also provide extension advice — and even inputs and credit — to their small food crop growers. More formalized partnerships, with some funding, could strengthen agricultural intensification efforts.

Support Development of Farmer Organizations. Greater collective action among small-scale farmers will be central to broad-based agricultural development. Organized farmer groups lower the cost of delivering extension information, facilitate farmer-to-farmer diffusion of knowledge, create pool input purchases and market surplus production, develop local savings and loan associations, and represent farmer interests in the political arena. As farmer associations grow, they can become alternative providers of technical information, augmenting government extension services.

The keys to success may be to (a) take advantage of natural groups and (b) organize around multiple purposes. Often informal groups already exist. They can be formalized by building on the natural structure of the society and identifying key interests around which to organize. Ultimately groups should have some legal structure — parts of share companies, cooperatives, etc. — to provide both transparency in rules, transactions and enforceability, unless overwhelming social consensus prevails.

Rural Credit

Smallholder farmers generally are poor and often do not have funds or credit to purchase necessary inputs prior to the production and sale of their crops. Credit is often necessary to purchase products for intensification and hold surplus grain stocks after harvest. The transactions costs of credit for many small loans to resource-poor farmers are large relative to the amount borrowed. Many countries have experienced problems with loan recoveries.

Rural finance usually is the weakest part of the food production system. Much freedom in designing new efforts is lost because of bad experience. Many failed

schemes have assumed that credit would pull in inputs. The system quickly can become politicized. Moreover, there can be too much credit too fast. Too many rural finance plans are designed as if they would encounter little or no risk, resulting in numerous system failures because of large defaults.

No widely applicable model has emerged. The basic principle is that credit should follow input demand rather than credit leading input demand. Ideally, farmers and traders would get credit from legally constituted and regulated banks; but such banks often are not nearby or willing to serve small growers. Consequently, interest rates may be prohibitively high.

There are several options for providing sustainable rural finance. Input dealers and grain traders can obtain credit to lend to farmers. To promote this, funding must be increased in rural areas. The second alternative might be self-finance with the following characteristics:

- Establish a base for self-financing linked to savings mobilization and including equity, as the basis for credit.
- Consider only activities that are profitable. (Some group micro-credit programs are not concerned with the uses of the credit only that it be repaid, leaving payment responsibilities to the group. This approach reduces transaction costs.)
- Charge market-level interest rates.
- Maintain an adequate spread between rates paid to depositors and rates charged to borrowers.
- Approve and disburse funds so that production inputs (seed, fertilizer, and labor) can be purchased at the appropriate time, before or during the production cycle.
- Minimize transactions costs.
- Provide credit in cash (not kind) so that farmers can make planning decisions for a total operation.
- Enforce repayment firmly, but in a way that recognizes that farmers may desire to withhold some funds to cover reasonable personal expenses.
- Provide management training in micro-credit operations.

Eventually a banking system must be developed that has branches closer to rural savers and borrowers.

Peer pressure that promotes discipline and accountability through organized groups (associations or cooperatives) may be a promising way to simplify credit approval, minimize transaction costs, and improve repayment. Groups formed only to obtain credit are seldom viable. Organizations that focus on wealth creation and a total business plan for the farmer hold greater promise of being sustainable since they increase options for the farmer. If the interest rate is too high to justify input loans,

the group could borrow to hold grain for seasonal storage and use those profits to purchase inputs. If a good storage facility could be built or leased, licensed and possibly bonded, this action would further facilitate loans. Stocks could be used as collateral — or might even facilitate futures sales, thereby hedging risk of seasonal storage.

While the benefits of existing farmer organizations are mainly reducing the transaction costs of acquiring and repaying credit through group schemes, these benefits can be extended to a broader range of input and output marketing activities.

Agricultural Input Supply

Agricultural intensification efforts in Sub-Saharan Africa will depend on sustainable supplies of productivity-enhancing inputs including improved seed, inorganic fertilizers, and plant protection chemicals. Nevertheless, input supply systems in most of these countries remain fragmented, distorted, and largely underdeveloped. They are distorted because governments pursue policies and interfere in the smooth functioning of markets. They are underdeveloped because the size of the market is small, technical know-how of dealers is limited, regulatory frameworks for quality control are absent, and market information networks do not exist. Consequently inputs, especially improved seed, are unavailable, and fertilizers are inaccessible and(or) unaffordable. Generally, other inputs also are in short supply: chemicals to help control weeds, insects, and diseases; power equipment for traction and harvesting; and pumps and piping for small irrigation systems.

Seed

Many Sub-Saharan National Agriculture Research Systems, usually with inputs from the International Agricultural Research Centers, have been successful in breeding improved varieties for most important food crops. However, these countries have been much less successful in developing seed industries. For example, although there are some notable exceptions including Zimbabwe, Kenya, and Zambia, only about 37 percent of maize crops grown in Sub-Saharan Africa (excluding South Africa) in 1992 were planted with improved varieties and hybrids (CIMMYT, 1994). Varietal registration systems, which approve specific varieties for commercial use, as well as seed certification services function poorly and some times not at all. Public seed corporations generally have performed unsatisfactorily, and most have been disbanded without adequate replacement by private seed companies.

Efficient seed variety registration and release mechanisms are needed for all seed, both publicly and privately developed. Increasing private sector research for hybrid maize and some cash crops is anticipated. For those crops with the greatest market potential, increasing activity by transnational seed companies is expected. Protection of intellectual property rights, reasonable varietal registration procedures, freedom to import and export seed, and of course, normal profit considerations will be key to

determining how quickly these companies invest in the African seed industry.

In many staple food crops — either because of relatively small market potential or the sexual reproductive nature of the crop (i.e., does not lend itself to hybridization) — publicly-funded national research systems or international research centers will be the primary source of improved genetic materials. While the germplasm development research will remain in the public domain, seed production and marketing should be largely left to the private sector or to community-based NGOs.

National crops research institutes should establish “seed units” staffed with well-trained technologists who are responsible for managing the seed chain from “breeder seed” through at least part of the “foundation seed” production phase. Transparent rules on access by private growers to public-sector germplasm should be established. In other parts of the world (Brazil, Thailand, Guatemala), National Agriculture Research Systems have earned considerable income from the sale of public sector germplasm to registered private seed growers and companies. These sales supplement government research funds. Similar public-private partnerships should be encouraged in Sub-Saharan Africa as well.

Seed for staple food crops is likely to be produced by small- and intermediate-scale commercial companies. Other crops are more likely to be produced by community-based farmer organizations in what are often referred to as “artisan seed” production systems. Here too, national crop research institute seed units (and the national seed service) need to play a role in training and technical support. There is an especially important part for NGOs to play in these types of seed production mechanisms, and their participation should be encouraged.

While improved germplasm often is the catalyst for the transformation of agricultural production systems, that action is not likely under conditions of low soil fertility. Improved varieties frequently are superior to local varieties in disease and insect resistance and tolerance to certain abiotic stresses, but their yield superiority will be expressed only with adequate soil fertility.

Fertilizer

A major constraint associated with macroeconomic and microeconomic factors at the farm level is the unavailability of fertilizers at affordable prices. Most countries in Sub-Saharan Africa do not have market demand and raw materials to justify primary production of fertilizers, where economies of scale are fundamental to efficient production. Therefore, in the near- and intermediate-term, most of these countries will depend on imports to satisfy fertilizer needs.

Macro-Level Interventions. At the macro level, three areas should receive priority: policies, programs, and actions. First, national governments and donors should work together to ensure adequate and timely supply of foreign exchange for fertilizer imports and technical know-how. Most Sub-Saharan countries suffer from foreign exchange shortages and depend largely on donor support. The donor community can

help ensure and sustain the supply of fertilizers and other modern inputs by providing foreign exchange, preferably in *untied* form and without unnecessary conditions. Second, donors, especially the World Bank and the International Monetary Fund, and national governments should work together to stabilize the exchange rate in countries where the continuous depreciation of domestic currency value discourages fertilizer import and private sector investment. Failing this, national governments should guarantee the exchange rate for a period of at least 6 months on foreign exchange needed for importing fertilizers and associated inputs. A guarantee can easily reduce the local price of fertilizers by 20 to 30 percent and promote their use by small farmers. Third, increasing liquidity with commercial banks is important to augment the supply of loan funds for the import and domestic sale of inputs and to reduce and stabilize real interest rates.

Strengthening Input Delivery Systems. At the micro-level, the development of self-sustaining dealer networks should receive high priority so that seed, fertilizer, and plant protection materials can be supplied at the village level. Dealer networks should be developed by implementing appropriate programs of institutional capacity building. In these programs, local private traders, unsubsidized cooperatives, and farmer organizations should be trained to supply inputs and advice to farmers. The local trading community often is bypassed as an effective marketing and distribution agent because of state monopolies that control import and distribution of inputs.

This untapped potential should be fully exploited, with proper training programs and technical assistance. These dealer networks not only will make inputs easily accessible to farmers but also significantly reduce marketing and distribution costs. Following development of dealer networks, commercial and development banks should become involved in financing fertilizer trade and using fertilizer as collateral for bank loans.

With bank involvement in financing fertilizer trade, dealers could be used as financial intermediaries to fund farmer input purchases, as is done in a number of countries.

National governments should develop proper regulatory frameworks and information management systems and eliminate political interference to ensure smooth functioning of input markets based on private sector participation. Given the small size of the fertilizer market, care should be taken to ensure that public monopolies are not replaced by private monopolies. No tariffs or taxes should be levied on import, production, or sale of fertilizer or other farm inputs in order to keep prices affordable for small farmers.

Most African countries have prevented the involvement of the private sector in input marketing, and for that reason, it has not yet fully developed to shoulder that responsibility. Additionally, it is not prepared to provide regulatory and market intelligence functions. A well-managed training program and technical assistance will be necessary to develop marketing skills and information networks within the private and public sectors. The donor community can collaborate with national

governments to fill this gap. The development of rural infrastructure, storage, and port facilities to reduce marketing and distribution costs will be another area for constructive partnerships.

Development of transportation networks and other infrastructure takes a long time and is generally a social responsibility because infrastructures are public goods. For example, it often is difficult to get teachers to accept positions in remote rural areas that do not have adequate road systems. Furthermore, the lack of infrastructure, along with the land-locked nature of many countries, results in substantially higher costs for fertilizers and other inputs (and substantially lower farmgate prices for produce). Should farmers alone be forced to bear this cost, when society-at-large benefits from increased food production, lower food prices and a sustainable natural resource base (soils, forests and biodiversity)? Should not all stakeholders share the cost of agricultural intensification in Africa? These basic issues need to be addressed.

Agricultural Marketing Systems¹

Agricultural product marketing reforms in many African countries are producing positive results. Between 1980 and 1995, privatization (withdrawal of state agencies from grain pricing and marketing) and liberalization (relaxation of regulatory controls on private marketing) of staple grain marketing has taken place in more than 20 Sub-Saharan countries. Although implementation has been slow and sporadic, food marketing policy has been transformed. Market liberalization is not an end in itself. In most African countries, marketing margins may approximate costs. These costs frequently are too high and unstable to encourage rapid private investment in the marketing system as a way to promote on-farm intensification and productivity growth. So far, market reforms have replaced often unreliable, high-cost, and centralized state marketing methods with more open and competitive markets. But these markets often lack information, innovation, and infrastructure and are poorly coordinated with other key activities.

The Need to Go Beyond Market Liberalization. Liberalized marketing systems in most of Africa are still characterized by:

- High transport costs
- Limited and costly legal recourse for private players in contract dispute
- High costs for information, especially about market conditions in neighboring countries
- Weak grades and standards and few forward markets involving high-volume trade on standardized specifications
- Limited liquidity because of the lack of mechanisms for using inventory as collateral

¹ This section, drafted by a team member, draws heavily from Jayne, T.S. et al., 1997.

- Limited group action to enhance farmer bargaining power and marketing practices
- Overall high market risks and price uncertainty for farmers and traders
- Weak coordination between input delivery, farm finance, and crop sale arrangements.

Further donor investments in these areas could make significant contributions to the improvement of farm product marketing systems.

Ways to create coordinated and sustainable systems of input delivery, farm finance, and reliable product markets is needed to reduce the cost and risks of input intensification in smallholder agriculture. National governments and the development community still are searching for successful models to show how these elements can be improved sustainably and linked, given the limited resources and high risks facing private investors.

Fiscal restrictions, imposed by the need for structural adjustment, will increase emphasis in the future on developing financially sustainable means of reducing the risks in the Sub-Saharan food system. Increased reliance will be placed on market-oriented mechanisms that exploit potential gains from local, regional, and international trade. The challenge is to make better strategic use of markets and private actions to induce cost-effective technical innovations to support agricultural intensification, structural transformation, and economic growth. Important steps that governments should consider to improve output marketing systems include:

Modify the Remaining State Marketing Boards' Pricing Policies and Change External Trade Policies to promote Regional Trade. Pan-territorial and pan-seasonal prices, still continued in some African countries, depress private investment in transportation and storage that ultimately could play a vital role in improving market integration and mitigating food price fluctuations.

Invest More to Nurture the Political, Legal, and Economic Foundations of Private Marketing Systems. A well-functioning legal and political framework for market activity reduces the risks and transaction costs of private trade. Strengthened mechanisms for specifying and enforcing contracts, raising the cost of contract non-compliance, and more pluralistic procedures for establishing the rules governing market activity are important adjuncts to developing reliable markets. Such measures inherently involve strengthening the regulatory abilities of the state rather than "getting the state out of market regulation."

Coordinate Policies and Investments to Gain Complementary Benefits from Higher-Valued Cash and Food Crop Production. In many areas of Africa, successful introduction and(or) promotion of high-valued cash crops can have strategic benefits that stimulate small-scale food crop production as well (e.g., cotton in Burkina Faso, Mali, and Mozambique). High-valued crops can be economic engines that help pull the demand and supply of fertilizer and other inputs, increasing affordability and availability of inputs for food crops. In addition, revenue from cash crop sales can

help to capitalize farmers and finance household investment in animal traction equipment and other inputs that promote both cash and food crop productivity improvements.

Invest in Local Analytical Research Capacity. Lasting market and related policy change depends on the confidence of governments in the analysis supporting the reforms. There is ample evidence that governments that have reluctantly undertaken market reform programs have reversed them and re-imposed the old system of price and trade controls with the advent of drought or other shocks. Continuing analytical work to monitor what is happening on the ground is critically important to maintaining the momentum of market reforms. Donors can help fund research so that objective data and analysis are available to policymakers.

Physical Infrastructure

Sub-Saharan Africa is beset with major infrastructure problems. Vast areas of the region are more than 500 miles from the sea, few navigable rivers penetrate far inland, and rural road systems are poorly developed and maintained. Consequently, transportation costs are high. Rural road construction does not offer particularly difficult engineering problems — there are few high mountain barriers, and the terrain is not generally rugged, though often deeply dissected. Road building material, e.g., laterite, often is in plentiful supply, yet rural road construction, like agricultural production, largely depends on human energy. Because of trypanosomiasis, large areas of Sub-Saharan Africa do not have draft animals. Consequently, local communities have fewer incentives to develop roads. As human population pressures force the tsetse fly (trypanosomiasis vector) further into retreat, and if researchers succeed in developing trypano-tolerant breeds of Boran cattle, then the transportation situation in large parts of region may be radically transformed.

Improvements in the road, rail, port, and communication infrastructure across Sub-Saharan Africa are of the highest priority. Donor support in these areas would make the market liberalization measures they advocate more successful. The dilemma is that improving transportation infrastructure is costly. Phased investments may be required that first *target high potential food and cash crop regions* where agricultural intensification is more likely to be financially sustainable. Several donors, including the World Bank, have detailed studies on rural transportation and have researched the cost of labor-intensive, vis-à-vis machine, construction. There also are studies on how rural roads could be financed and maintained, even by rural communities.

Other transportation issues also must be addressed. One major challenge is how to lower transportation costs from ports to land-locked countries. Functioning economic free-trade zones will help overcome the high transaction costs. Removal of various port handling fees, transportation taxes, and border licenses also is important.

In some areas of the region, freight volume is high enough to make rail and even water transportation systems potentially economical. Additional investments need to

be made in these lower-cost means of transportation. Here, multi-country cooperation will be important, and perhaps essential, to success.

Finally, development of telecommunications in Sub-Saharan Africa is essential if an efficient agricultural sector is to emerge. In an efficient market economy, the importance of timely and low-cost information systems cannot be over stressed. Rapid developments in digital and cellular technology, satellite communications, and solar energy afford Sub-Saharan countries with the opportunity to “leap-frog” over previous telecommunications technology, avoiding much of the “hard-wiring” and electric power grid investments previously required. The private sector, both national and international, can make the telecommunication investments needed if governments will allow them to do so.

■ Opportunities for the International Donor Community

This report identifies some excellent opportunities for increased investments in activities to support agricultural intensification in Sub-Saharan Africa, by national governments, national and international private-sector interests, and the international donor community. Although there are strong altruistic and humanitarian reasons to assist people and nations in distress — such as those in Sub-Saharan Africa — neither the private sector nor donors need to base their assistance on these motivations alone. It is in their self-interest to do so.

Improving social and economic conditions in Sub-Saharan Africa should, unquestionably, contribute to peace and stability in the region — with positive global implications. Moreover, it would be far better to help these countries feed themselves than to provide enormous quantities of food aid in times of crisis and famine, a circumstance which has occurred all too frequently in recent years. The case of increased fertilizer use presents a compelling example. Because of the high cost of delivering fertilizer to the farmer and low farmgate grain prices, fertilizer use, from the farmer perspective, may not appear to be profitable on food crops. However, this report illustrates how targeted assistance from the international donor community could make fertilizer use more profitable — as it is in more developed regions — by increasing the efficiency of use, reducing the cost to the farmer, and increasing market prices for farm products. There are excellent opportunities for improvement in these areas.

It is in the self interest of more developed nations to provide donor assistance. Africa represents an enormous potential market for the industrialized world. However, poor people make poor customers. Consequently, Africa represents enormous potential that never can be realized unless the economies of Sub-Saharan countries can be significantly improved. Developing these markets has tremendous implications for private-sector interests in both industrialized and developing countries.

Historically, there has been a strong correlation between developing countries

with high agricultural growth rates and those with increased imports, including agricultural products. Imports have grown not because domestic production has failed, but because rising incomes have sparked stronger domestic demand for products than expanded domestic production could satisfy.

Although the severe indebtedness of many African countries may weaken this correlation somewhat, accelerated growth in the agricultural sector certainly will lead to increased imports of agricultural and manufactured products. Only by building an expanding global economy in which more people achieve adequate consumption levels, can we reasonably assure a prosperous long-term future for countries like the United States where agricultural and industrial product exports contribute greatly to the national economy.

It has been well-documented that investments in international agricultural research have been extremely effective in reducing poverty and hunger in developing countries. Recent work by IFPRI has shown that these investments have direct economic benefits for industrialized countries as well. For example, CIMMYT's wheat research has generated returns as great as 190 times the total U.S. contribution to CIMMYT's wheat improvement budget. United States support of rice research at IRRI has yielded as much as 17 times the amount invested (Pardey, et al., 1996).

Well-focused agricultural research will certainly be needed to prime the "development pump." For research to achieve full impact, large investments also will be needed in transportation, energy, and communications infrastructures, as well as agricultural input delivery, output marketing, and financial systems. While there is still a long way to go, there are promising signs on the horizon. The emerging African leadership appears to have a more pragmatic, market-oriented vision of development. With increased private and public investment in agriculture and other sectors, the standards of living for millions of African people can be improved significantly over the next two decades.

The application of high-yielding agricultural science and technology — along with market reforms, trade liberalization, and sound macroeconomic policies — will lead Africa to greater prosperity. Without agricultural improvement, there can be no sustained reduction in poverty. Yet we often forget that the agricultural production base in Sub-Saharan has not been secured. These nations must get back to the basics and improve agricultural productivity and output. There is urgent need for greater donor support of these efforts.

The urgency of this problem was emphasized recently by Nobel Peace laureate Dr. Norman Borlaug:

Unless there is a major increase in food production in SSA in the next 6 to 8 years, I believe it is highly probable there will be massive migration of destitute, hungry, miserable people, illegally crossing borders of SSA countries, creating social, economic, and political chaos that will affect the world. . . Moreover, these people will not be stopped by either deserts or oceans in their desperate search for survival.



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